Geophysical Research Abstracts, Vol. 9, 06867, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06867

Mass balance and anisotropy issues in the geophysical monitoring of controlled water injection experiments in the vadose zone.

G. Cassiani(1), R. Deiana(2) and A. Kemna(3)

(1) Dipartimento di Geoscienze, Università di Padova, Padova, Italy (giorgio.cassiani@unipd.it), (2) (2) Dipartimento di Scienze Geologiche e Geotecnologie, Università degli Studi di Milano Bicocca, Piazza della Scienza 4, Milano, Italy (rita.deiana@unimib.it), (3) Institute of Chemistry and Dynamics of the Geosphere, Forschungszentrum Juelich GmbH, Juelich, Germany (a.kemna@fz-juelich.de).

The characterization of the vadose zone by means of controlled water injection experiments has become increasingly popular as the use of non-invasive (geophysical) techniques allow for effective and relatively inexpensive monitoring of the injected water movement during the experiment. However, the process of converting geophysical data into quantitative estimates of volumetric water content and/or solute concentrations is not straightforward, as it requires knowledge of (1) resolution and penetration characteristics of the geophysical methods (imaging characteristics); (2) suitable constitutive laws for the conversion of geophysical quantities into hydrologic quantities (petrophysics). If the water is injected in a single point, spatial moment analysis of the water content excess derived from geophysical is a useful tool to condense the information contained in the data. The moment values evolution over time can then be used to calibrate unsaturated flow models. This methodology has proven successful in a number of field cases. However, important issues are still unresolved, particularly with regard to the identification of second order spatial moments (spread) and, more disturbing, mass balance. The difficulty in identifying the second moment poses severe limitations to the understanding of system anisotropy, that is linked to different spread in different directions. As for mass balance, field experience demonstrates that it is rarely possible to “see” the total injected tracer mass by means of a non invasive method, be it cross-hole ERT or GPR, leading often to errors of the order of 50%. The reasons of these limitations lie mostly in the imaging characteristics of the methods.

In this contribution we present how a suitable combination of GPR and ERT imaging characteristics may circumvent the mass balance problem and help identify anisotropy at the field scale.